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(54) METHOD OF MILKING

MELKVERFAHREN

PROCEDE DE TRAITE

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Description

The present invention relates to a method of milking an animal by using a milking machine having at least one teat cup with a teat cup liner therein for receiving a teat of the animal, a pulsation chamber being defined between the teat cup and the teat cup liner. There are means for subjecting the pulsation chamber to a pulsating pressure varying between a first pressure and a sub-atmospheric second pressure, which is lower than said first pressure. Each pulsation of said pulsating pressure includes a pressure decreasing phase, during which the pulsating pressure decreases from said first pressure to said second pressure, and a pressure increasing phase, during which the pulsating pressure increases from said second pressure to said first pressure. Means are provided for subjecting the interior of the teat cup liner to said sub-atmospheric second pressure for extracting milk from the animal's teat. The milking of the animal includes in sequence an initial massage period, during which the milk flow begins, a main flow period, during which the milk flow first increases to a main flow and then continues at said main flow, a flow decreasing period, during which the milk flow at first for a short while amounts to said main flow and then decreases, and a flow terminating period, during which the milk flow ceases.

When milking mechanically it is desirable that the milking of each animal, such as a cow, takes place rapidly, so that the milking machine is efficiently utilized. However, the more rapid the milking operation is carried out, the more milk that will remain in the udder at the end of the milking operation. This remaining milk, know as "rest milk", must be extracted by manual manipulation of the milking machine, which is labour intensive. Alternatively, the rest milk is simply left in the udder until the next milking occasion, which results in a reduction of extracted milk. In addition, a more rapid milking has the consequence that the teat periodically, especially at the end of the milking, is treated urgently, which may give rise to injuries to the teat and deteriorate udder health.

In US-A-4391221 there is described a method of milking an animal wherein the teat is stimulated during a stimulation phase for a predetermined interval prior to the principal milking operation. During the stimulation phase, no milk is removed, the maximum underpressure applied to the pulsation chamber during each pulsation is less than half that applied during milk removal, the pulsation frequency is several times that during milk removal and the pressure rises and falls during each pulsation at a slower rate than during milk removal.

The object of the present invention is to provide a method of milking, which enables a relatively rapid milk extraction, reduces the rest milk and results in a gentle treatment of the cow's teats.

This object can be obtained by means of a method of the kind initially stated, which is characterized by operating the milking machine to change the pulsating pressure during at least one of said pressure decreasing phase and said pressure increasing phase of each pulsation at a slower rate during at least one of said massage period, flow decreasing period and flow terminating period than during said main flow period.

As a consequence, the teat cup liner will move slower during opening and/or closing of the interior of the teat cup liner during any of said periods of the milking. A slower opening of the interior of the teat cup liner means that the teat has more time to expand radially and maintains its frictional engagement with the teat cup liner, whereby the teat cup is prevented from crawling upwards on the teat towards the udder and from causing a throttling of the milk conducting interior of the teat close to the udder. Such a crawling of the teat cup makes the milking more difficult and gives rise to increased rest milk. A slower closing of the interior of the teat cup liner means that the teat is treated more gently by the teat cup liner.

During the main flow period, when the larger quantity of the milk is extracted, the pulsating pressure in the pulsation chamber changes at a normal rate, which means that the total milking still can be carried out relatively rapidly.

The invention is explained more closely below with reference to the accompanying drawings, in which figure 1 is a graph, which illustrates the size of the milk flow during a milking operation, figures 2-4 are three graphs illustrating the cyclic course of the pressure in a pulsation chamber according to three alternative milking operations according to the invention, and figures 5-7 schematically show three alternative milking machines for accomplishing the milking method according to the invention.

In the graph according to figure 1 there is shown a typical relation between milk flow Q and time t during milking of a cow. During an initial massage period I the teats of the cow are stimulated, so that the milk yield begins. Thereafter a main period II follows, during which the milk flow increases to a main flow, and then stays relatively constant for a substantial part of the main period II. Following the main period II is a milk flow decreasing period III during which the milk flow for a first short time amounts to the main flow and then steadily decreases. Finally a milk flow terminating period IV occurs, during which the milk flow ceases.

In the pressure/time graphs according to figures 2-4, there is illustrated by a continuous line 1 how the pulsating pressure in a pulsation chamber of a teat cup provided with a teat cup liner varies between a high pressure P_1 and a low pressure P_2 during a pulsation cycle. During an opening phase a (see figure 3) the pulsating pressure is decreased from the value P_1 to the value P_2, which results in that the interior of the teat cup liner is opened and milk can flow from the teat. During a following milking phase b (see figure 2) the pulsating pressure is kept at the value P_2, the interior of the teat cup liner being kept open. Then, a closing phase c follows, during which the pulsating pressure according to the line 1 is increased from the value P_2 to the value P_1,

which results in that the interior of the teat cup liner is closed and milk is prevented from flowing from the teat. During a following rest phase d the pulsating pressure is kept at the value P_1, the interior of the teat cup liner being kept closed. A pulsation cycle comprising the phases a-d usually lasts between 0.7 to 1.5 seconds.

In the graph according to figure 2, there is illustrated by a broken line 2 how the opening phase a is prolonged if the pulsating pressure decreases at a slower rate than along the line 1. The prolongation of the opening phase a means that the interior of the teat cup liner is opened at a slower rate.

In the graph according to figure 3, there is illustrated by a broken line 3 how the closing phase c is prolonged if the pulsating pressure increases at a slower rate than along the line 1. The prolongation of the closing phase c means that the interior of the teat cup liner is closed at a slower rate.

In the graph according to figure 4, there is illustrated by the broken lines 2 and 3 how both the opening phase a and the closing phase c are prolonged, if the pulsating pressure changes at a slower rate than along the line 1. (The pulsating pressure both increases and decreases at slower rate). Thus, the prolongation of the opening phase a and the closing phase c means that the interior of the teat cup liner is opened and closed at a slower rate during the same pulsation cycle.

The milking machine shown in figure 5 comprises a teat cup 4 with a teat cup liner 5, a pulsation chamber 6 being defined between the teat cup 4 and the teat cup liner 5. From the interior of the teat cup liner 5 a milk passage 7 leads to a receptacle 8, the interior of which is subjected to a sub-atmospheric low pressure P_2 by a low pressure source 9 via a low pressure passage 10. A pulsator 11 is connected to the pulsation chamber 6 via a pulsation passage 12, to the low pressure source 9 via a low pressure passage 13, and to a high pressure source 14, which generates a high pressure P_1, via a high pressure passage 15. The passages 12, 13 and 15 are provided with controllable valves 16, 17 and 18, respectively. A control unit 19 is connected to the valves 16, 17 and 18 for controlling these.

The milking machine according to figure 5 is operated in the following way. The low pressure source 9 subjects the interior of the teat cup liner 5 to the low pressure P_2 via the passage 10, the interior of the receptacle 8 and the passage 7, while the pulsator alternately subjects the pulsation chamber 6 to the high pressure P_1 from the high pressure source 14 via the passages 15 and 12, and to the low pressure P_2 from the low pressure source 9 via the passages 13 and 12. When the low pressure P_2 prevails in both the pulsation chamber 6 and the interior of the teat cup liner (phase b) the interior of the teat cup liner 5 is fully opened, milk being able to flow from a teat, which is inserted into the teat cup 4 from above, to the receptacle 8 via the passage 7. When the high pressure P_1 prevails in the pulsation chamber 6 (phase d) the teat cup liner 5 is flattened below the teat by the resulted pressure difference between the outside and the inside of the teat cup liner 5, so that the interior of the teat cup liner is closed. By means of the control unit 19 and the valves 16-18, the opening and closing rates of the teat cup liner 5 can be optimally controlled during milking. E.g., both the opening rate and the closing rate of the teat cup liner can be reduced by throttling the pulsation channel 12 by means of the valve 16 (fig 4). As an alternative, only the opening rate of the teat cup liner 5 may be reduced by throttling the low pressure passage 13 by means of the valve 17 (fig 2), or the closing rate of the teat cup liner 5 may be reduced by throttling the high pressure passage 15 by means of the valve 18 (fig 3).

One of the opening rate and closing rate of the teat cup liner, or alternatively both, can optionally be reduced during any of the massage period I, the flow decreasing period III and the flow terminating period IV. E.g., both the opening rate and the closing rate of the teat cup liner can be reduced during all of these periods, which gives the best protection against teat cup crawling, the most gentle teat treatment and a small amount of rest milk, but a prolonged milking, since the milking phase b and the rest phase d (the recovery phase of the teat) will be shortened during said periods. As an alternative, the duration of the rest phase d can be kept normal by only reducing the opening rate of the teat cup liner 5, which shortens the milking time somewhat, but gives a somewhat worse teat treatment. Another alternative is to reduce the opening and closing rates of the teat cup liner 5 only during the flow decreasing period III, which substantially reduces the risk of teat cup crawling. Yet another alternative is to reduce the opening rate of the teat cup liner 5 only during the flow decreasing period III and the flow terminating period IV, while the closing rate of the teat cup liner 5 is reduced during the massage period I, the flow decreasing period III and the flow terminating period IV.

The milking machine according to figure 6 differs from the milking machine according to figure 5 in that the control unit 19 only is connected to a valve 20, which is arranged in a connection passage 21 A between the high pressure source 14 and the low pressure passage 13, and to a valve 20 A, which is arranged in a connection passage 21 between the low pressure source 9 and the high pressure passage 15. By means of the control unit 19 and the valve 20, a small leakage from the high pressure source 14 to the low pressure passage 13 via the connection passage 21 A can be provided, so that the pressurization of the pulsation space 6 of the low pressure source 9 takes place at a slower rate, whereby the interior of the teat cup liner 5 is opened at a slower rate. As an alternative, a small leakage from the high pressure passage 15 to the low pressure source 9 may be provided by means of the control unit 19 and the valve 20 A, so that the pressurization of the pulsation space 6 by the high pressure source 14 takes place at a slower rate, whereby the interior of the teat cup liner 5 is closed at a slower rate.

The milking machine according to figure 7 differs

from the milking machine according to figure 5 in that an accumulation chamber 22 is connected to the pulsation passage 12 via a passage 23, which is provided with a valve 24, and in that an accumulation chamber 25 is connected to the high pressure passage 15 via a passage 26, which is provided with a valve 27, and to the low pressure passage 13 via a passage 28, which is provided with a valve 29, the control unit 19 being connected to the valves 24, 27 and 29. When the control unit 19 opens the valve 24 during milking, also the accumulation chamber 22 will be alternately pressurized by the pressure sources 9 and 14, which results in that a corresponding pressurization of the pulsation chamber 6 takes place at slower rate, so that the opening and closing rates of the teat cup liner 5 are reduced.

In case it is desirable to decrease only the opening rate of the teat cup liner 5, the control unit 19 controls the valves 27 and 29 during each pulsation cycle, so that during the a-phase the valve 27 is closed while the valve 29 is opened, the accumulation chamber 25 communicating with the low pressure passage 13. When the b-phase begins the control unit 19 closes the valve 29 and then opens the valve 27, so that the accumulation chamber 25 is pressurized by the high pressure source 14. When the d-phase begins the valve 27 is closed, after which the above described operation is repeated during the next pulsation cycle.

In case it is desirable to reduce only the closing rate of the teat cup liner the control unit 19 controls the valves 27 and 29 during each pulsation cycle, so that during the c-phase the valve 29 is closed hile the valve 27 is opened, the accumulation chamber 25 communicating with the high pressure passage 15. When the d-phase begins, the control unit 19 closes the valve 27 and then opens the valve 29, so that the accumulation chamber 25 is pressurized by the low pressure source 9. When the b-phase begins the valve 29 is closed, after which the above described operation is repeated during the next pulsation cycle.

The high pressure source 14 in the milking machine according to figures 5-7 is suitably constituted by atmospheric pressure.

Claims

1. A method of milking an animal by using a milking machine having at least one teat cup (4) with a teat cup liner (5) therein for receiving a teat of the animal, a pulsation chamber (6) being defined between the teat cup and the teat cup liner, means (9, 11-15) for subjecting the pulsation chamber to a pulsating pressure varying between a first pressure and a sub-atmospheric second pressure lower than said first pressure, each pulsation of said pulsating pressure including a pressure decreasing phase (a), during which the pulsating pressure decreases from said first pressure to said second pressure, and a pressure increasing phase (c), during which the pulsating pressure increases from said second pressure to said first pressure, and means (7-10) for subjecting the interior of the teat cup liner to said sub-atmospheric second pressure for extracting milk from the animal's teat, the milking of the animal including in sequence an initial massage period (I), during which the milk flow (Q) begins, a main flow period (II), during which the milk flow first increases to a main flow and then continues at said main flow, a flow decreasing period (III), during which the milk flow first shortly amounts to said main flow and then decreases, and a flow terminating period (IV), during which the milk flow ceases, **characterized by** operating the milking machine to change the pulsating pressure during at least one of said pressure decreasing phase (a) and said pressure increasing phase (c) of each pulsation at a slower rate during at least one of said massage period (I), flow decreasing period (III) and flow terminating period (IV) than during said main flow period (II).

2. A method of milking according to claim 1, **characterized by** operating the milking machine to decrease the pulsating pressure during said pressure decreasing phase (a) of each pulsation at a slower rate during the massage period (I), the flow decreasing period (III) and the flow terminating period (IV) than during the main flow period (II).

3. A method of milking according to claim 2, **characterized by** operating the milking machine to increase the pulsating pressure during said pressure increasing phase (c) of each pulsation at a slower rate during the massage period (I), the flow decreasing period (III) and the flow terminating period (IV) than during the main flow period (II).

4. A method of milking according to claim 1, **characterized by** operating the milking machine to change the pulsating pressure during each pulsation at a slower rate during the flow decreasing period (III) than during the massage period (I), the main flow period (II) and the flow terminating period (IV).

5. A method of milking according to claim 1, **characterized by** operating the milking machine to decrease the pulsating pressure during said pressure decreasing (a) phase of each pulsation at a slower rate during the flow decreasing period (III) and the flow terminating period (IV) than during the main flow period (II) and the massage period (I), and to increase the pulsating pressure during said pressure increasing (c) phase of each pulsation at a slower rate during the massage period (I), the flow decreasing period (III) and the flow terminating period (IV) than during the main flow period (II).

Patentansprüche

1. Verfahren zum Melken eines Tieres unter Verwen-

dung einer Melkmaschine, umfassend

mindestens einen Zitzenbecher (4) mit einem darin befindlichen Zitzengummi (5), um eine Zitze des Tieres aufzunehmen;
eine Pulskammer (6), die zwischen dem Zitzenbecher und dem Zitzengummi definiert ist;
eine Einrichtung (9, 11-15), um die Pulskammer einem pulsierenden Druck zu unterwerfen, der zwischen einem ersten Druck und einem zweiten Unterdruck variiert, der kleiner ist als der erste Druck, wobei jeder Puls des pulsierenden Druckes eine Druckminderungsphase (a) umfaßt, während der der pulsierende Druck vom ersten Druck auf den zweiten Druck absinkt, und eine Druckanstiegsphase (c), während der der pulsierende Druck vom zweiten Druck auf den ersten Druck ansteigt; und
eine Einrichtung (7-10), um das Innere des Zitzengummis dem zweiten Unterdruck auszusetzen, wodurch der Zitze des Tieres Milch entzogen wird, wobei das Melken des Tieres in Reihenfolge aus einer Massageperiode (I) besteht, während der der Milchfluß (Q) einsetzt, einer Hauptflußperiode (II), während der der Milchfluß zuerst auf einen Hauptfluß ansteigt und dann bei diesem Fluß verbleibt, und einer Flußabnahmeperiode (III), während der der Milchfluß zuerst kurz bei der Menge des Hauptflusses verbleibt und dann abnimmt, sowie einer Flußendeperiode (IV), während der der Milchfluß aufhört,

gekennzeichnet durch Betreiben der Melkmaschine, um den pulsierenden Druck mindestens während einer der Druckabnahmephasen (a) oder der Druckanstiegsphasen (c) von jedem Puls mindestens während der Massageperiode (I), der Flußabnahmeperiode (III) und der Flußendeperiode (IV) mit einer geringeren Rate zu ändern, als während der Hauptflußperiode (II).

2. Verfahren zum Melken nach Anspruch 1, **gekennzeichnet durch** Betreiben der Melkmaschine, um den pulsierenden Druck während der Druckabnahmephase (a) von jedem Puls während der Massageperiode (I), der Flußabnahmeperiode (III) oder der Flußendeperiode (IV) mit einer geringeren Rate zu verringern, als während der Hauptflußperiode (II).

3. Verfahren zum Melken nach Anspruch 2, **gekennzeichnet durch** Betreiben der Melkmaschine, um den pulsierenden Druck während der Druckanstiegsphase (c) von jedem Puls während der Massageperiode (I), der Flußabnahmeperiode (III) oder der Flußendeperiode (IV) mit einer geringeren Rate zu erhöhen, als während der Hauptflußperiode (II).

4. Verfahren zum Melken nach Anspruch 1, **gekennzeichnet durch** Betreiben der Melkmaschine, um den pulsierenden Druck von jedem Puls während der Flußabnahmeperiode (III) mit einer geringeren Rate zu ändern, als während der Massageperiode (I), der Hauptflußperiode (II) und der Flußendeperiode (IV).

5. Verfahren zum Melken nach Anspruch 1, **gekennzeichnet durch** Betreiben der Melkmaschine, um den pulsierenden Druck während der Druckabnahmephase (a) von jedem Puls während der Flußabnahmeperiode (III) und der Flußendeperiode (IV) mit einer geringeren Rate zu verringern, als während der Hauptflußperiode (II) und der Massageperiode (I), und um den pulsierenden Druck während der Druckanstiegsphase (c) von jedem Puls während der Massageperiode (I), der Flußabnahmeperiode (III) und der Flußendeperiode (IV) mit einer geringeren Rate zu erhöhen, als während der Hauptflußperiode (II).

Revendications

1. Procédé pour traire un animal en utilisant une trayeuse comportant au moins un gobelet trayeur (4) comportant au moins une étui (5) logé dans ce gobelet trayeur pour recevoir le trayon de l'animal, une chambre de pulsation (6) étant définie entre le gobelet trayeur et son étui, des moyens (9,11-15) pour soumettre la chambre de pulsation à une pression pulsatoire variant entre une première pression et une seconde pression sous-atmosphérique, inférieure à ladite première pression, chaque pulsation de ladite pression pulsatoire comprenant une phase de réduction de pression (a) pendant laquelle la pression pulsatoire diminue depuis ladite première pression jusqu'à ladite seconde pression, et une phase d'accroissement de pression (c) pendant laquelle la pression pulsatoire augmente de ladite seconde pression jusqu'à ladite première pression, des moyens (7-10) pour soumettre l'intérieur de l'étui du gobelet trayeur à ladite seconde pression sous-atmosphérique pour extraire du lait à partir du trayon de l'animal, la traite de l'animal incluant successivement une période initiale de massage (i) pendant laquelle l'écoulement (Q) du lait commence, une période d'écoulement principal (II) pendant laquelle l'écoulement de lait commence tout d'abord à augmenter jusqu'à un écoulement principal, puis se poursuit au niveau dudit écoulement principal, une période de réduction de l'écoulement (III) pendant laquelle l'écoulement de lait tout d'abord augmente rapidement pour atteindre ledit écoulement principal, puis diminue, et une période d'achèvement de l'écoulement (IV) pendant laquelle l'écoulement du lait cesse, caractérisé en ce qu'on fait fonctionner la machine à traire de manière à modifier la pression pulsatoire pendant

au moins l'une desdites phases comprenant au moins ladite phase de réduction de pression (a) et ladite phase d'augmentation de pression (c) de chaque pulsation, à une cadence plus lente pendant au moins l'une desdites périodes comprenant ladite période de massage (I), ladite période de réduction de l'écoulement (III) et ladite période d'achèvement de l'écoulement (IV), que pendant ladite période d'écoulement principal (II).

2. Procédé de traite selon la revendication 1, caractérisé en ce qu'on fait fonctionner la machine à traire de manière à réduire la pression pulsatoire pendant ladite phase de réduction de pression (a) de chaque pulsation à une cadence plus lente pendant la période de massage (I), la période de réduction de l'écoulement (III) et la période d'achèvement de l'écoulement (IV), que pendant la période d'écoulement principal (II).

3. Procédé de traite selon la revendication 2, caractérisé en ce qu'on fait fonctionner la machine à traire pour augmenter la pression pulsatoire pendant ladite phase d'augmentation de pression (c) de chaque pulsation à une cadence plus faible pendant la période de massage (I), pendant la période de réduction de l'écoulement (III) et pendant la période d'achèvement de l'écoulement (IV), que pendant la période d'écoulement principal (II).

4. Procédé de traite selon la revendication 1, caractérisé en ce qu'on fait fonctionner la machine à traire pour modifier la pression pulsatoire pendant chaque pulsation à une cadence plus faible pendant la période de réduction de l'écoulement (III) que pendant la période de massage (I), pendant la période d'écoulement principal (II) et pendant la période d'achèvement de l'écoulement (IV).

5. Procédé de traite selon la revendication 1, caractérisé en ce qu'on fait fonctionner la machine à traire de manière à réduire la pression pulsatoire pendant ladite phase de réduction de pression (a) de chaque impulsion à une cadence plus faible pendant la période de réduction de l'écoulement (III) et pendant la période d'achèvement de l'écoulement (IV), que pendant la période d'écoulement principal (II) et pendant la période de massage (I) et de manière à augmenter la pression pulsatoire pendant ladite phase d'augmentation de pression (c) de chaque pulsation, à une cadence plus faible pendant la période de massage (I), pendant la période de réduction de l'écoulement (III) et pendant la période d'achèvement de l'écoulement (IV) que pendant la période d'écoulement principal (II).

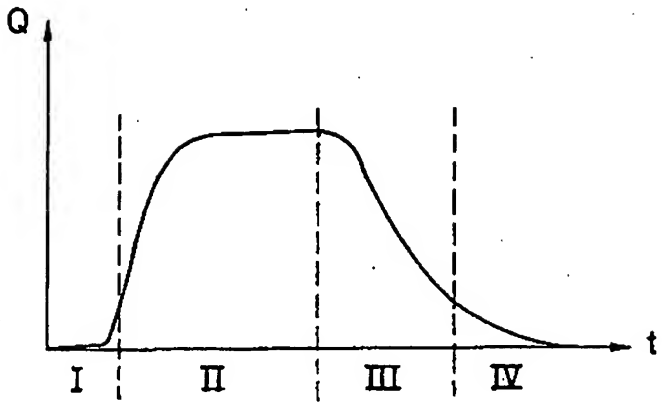

Fig.1

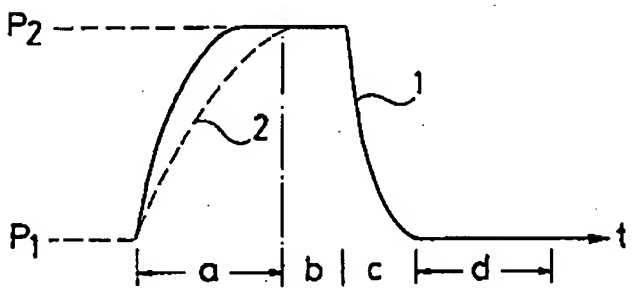

Fig.2

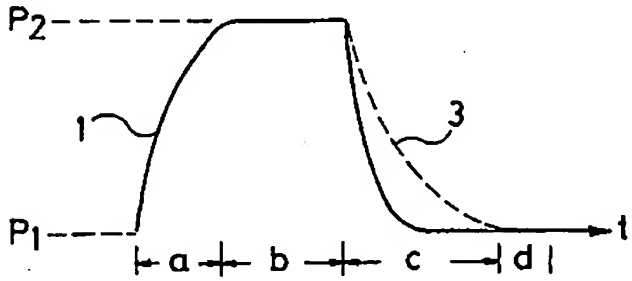

Fig.3

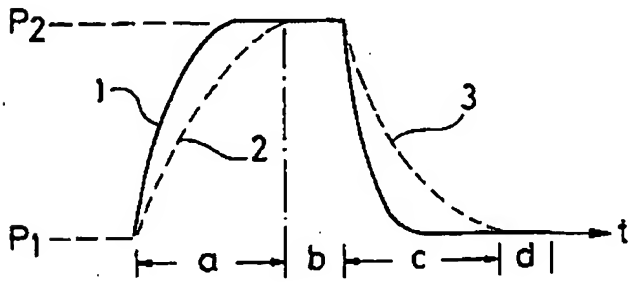

Fig.4

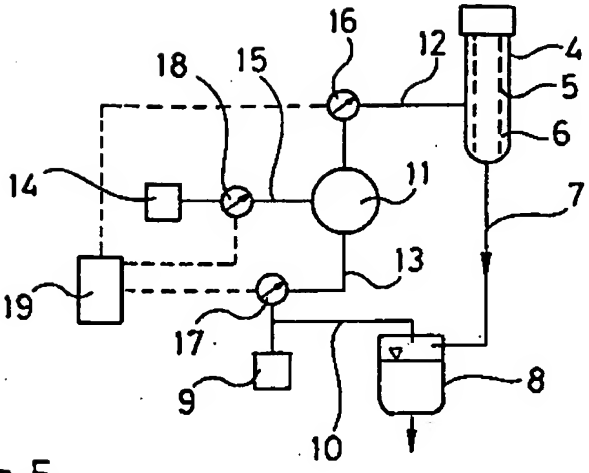

Fig.5

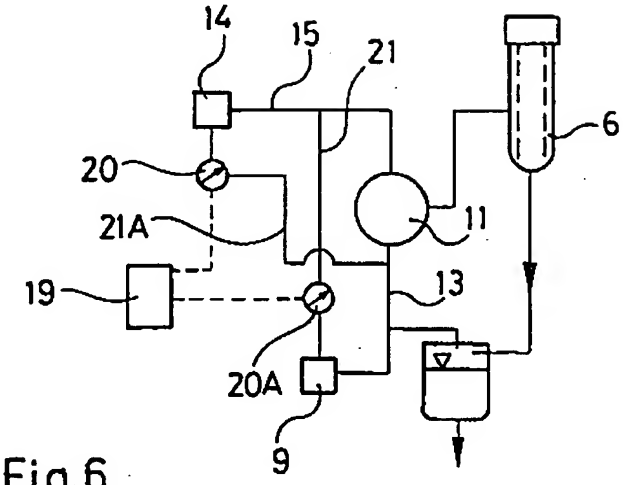

Fig.6

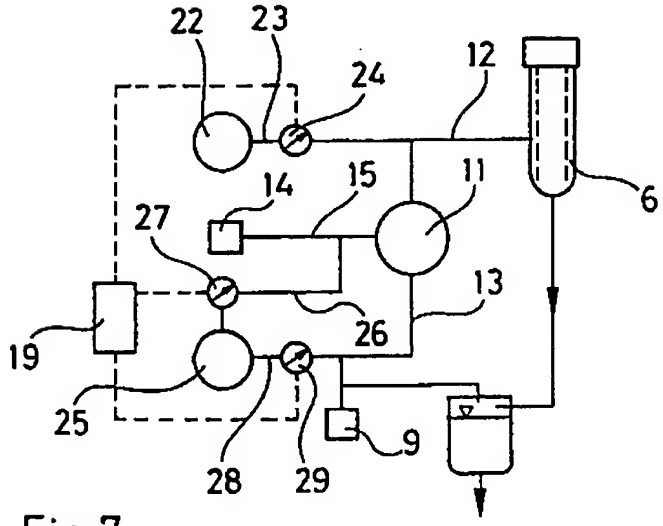

Fig.7